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Division of Animal Husbandry

Lamb Feeding Experiments

by
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¹In cooperation with the State Committee on the Relation of Electricity to Agriculture

²In cooperation with the United States Department of Agriculture.

LAMB FEEDING EXPERIMENTS

By

H. Hackedorn, J. Sotola, and H. P. Singleton

Various Grains for Fattening Lambs

Whole wheat, oats, barley, shelled eastern No. 3 yellow corn, and corn grown on irrigated land of the lower Yakima valley have been tested as feeds for fattening lambs for three years.

The feeder or "cut back" lambs from the Washington range bands are a little heavy for best feeding purposes. The average weights per lamb varied from 70 to 74 pounds per group. All lambs were uniform in quality and condition. They were sired by Hampshire rams and their dams were the long-wool and fine-wool cross commonly used by the range men in central Washington.

Baart, a hard white spring wheat, was the variety used the first two years. Turkey, a hard red winter variety, was used the third year. These wheats were produced under dry farming conditions. The barley was grown under similar conditions in eastern Washington. The No. 3 yellow corn came from the corn belt area, while the local corn was grown under irrigation at the Washington Irrigation Branch Experiment Station at Prosser. The oats were Banner, a heavy white variety, grown under irrigation. The hay used was good No. 1 green alfalfa, having 42 to 44 per cent leaves and grown at the experiment station. Dakota-grown speltz was fed one year. The chemical analysis of these feeds will be found on page 15.

The lambs were rated as "good" in their degree of finish. It would have required about 30 days longer to make them "choice." The only marked difference was the higher finish of the corn-fed group. Each year these lambs ranked the highest in finish and in daily gain. The wheat, barley, and oat fed lambs ranked very close, but were placed in the order named. The lambs receiving the speltz were rated decidedly lower in finish and in daily gain than the lots fed other small grains. The average results of the three years' work are presented in Table 1.

Table 1. Comparative Value of Whole Wheat, Barley, Oats, Eastern and Local Corn, and Speltz, for Fattening Lambs

Ration fed	Wheat, alfalfa hay	Barley, alfalfa hay	Oats, alfalfa hay	Eastern corn, alfalfa hay	Local corn, alfalfa hay	Speltz, alfalfa hay
No. of lambs fed	100	100	100	100	50	24
No. of days fed	60.3	60.3	60.3	60.3	60.5	59.0
Average Weights and Gains (Pounds)						
Initial wt. per lamb	74.17	74.97	73.46	73.36	73.84	77.43
Final wt. per lamb	91.91	92.16	90.57	93.97	94.80	92.33
Total gain per lamb	17.74	17.19	17.11	20.61	20.96	14.90
Av. daily gain per lamb	.294	.285	.284	.342	.346	.252
Average Daily Ration (Pounds)						
Grain	1.104	1.104	1.104	1.104	1.028	1.000
Alfalfa hay consumed ¹	1.890	1.863	1.899	1.871	2.020	2.300
Pounds Feed per Cwt. Gain						
Grain	375.4	387.5	388.6	322.4	297.1	397.0
Alfalfa hay consumed ¹	642.6	689.0	668.4	546.3	583.8	913.1

¹ The amount of long green No. 1 alfalfa hay fed was 23 per cent more than was consumed. Three per cent more of a similar quality of hay was fed chopped than was consumed.

One ton of eastern corn, as the standard, has the following replacing value, based on the feed consumed as summarized in Table 1:

- (a) 2328 pounds wheat plus 597 pounds alfalfa hay.
- (b) 2404 pounds barley plus 885 pounds alfalfa hay.
- (c) 2411 pounds oats plus 757 pounds alfalfa hay.
- (d) 1843 pounds local corn plus 233 pounds alfalfa hay.
- (e) 2463 pounds speltz plus 2275 pounds alfalfa hay.

The relative efficiency of the various grains and alfalfa hay in producing gains on the average lamb fed in these trials has been calculated from the feed required per 100 pounds gain, and the average daily gains (Table 2). It shows the total amount of the feeds of the various rations required to produce a gain of 15 to 30 pounds, on lambs weighing approximately 75 pounds, when fed on a ration made

up of one pound grain and nearly two pounds of hay, (see average daily ration, Table 1), and the time required to reach the stated gains with the various rations.

By multiplying amount of feed by local prices, the comparative feed costs can easily be obtained. At equal feed costs, corn has the advantage of producing fat lambs that would sell for two to three per cent more per hundred pounds than the wheat- or barley-fed groups. The lambs fed wheat, barley, and oats were valued equally on the market; the speltz-fed group was rated five per cent lower.

Table 2 presents the calculated feed required per lamb to produce various gains. If long alfalfa hay is fed in place of chopped hay, the results of the feeding trials at the station show that 18 per cent more hay should be fed.

Table 2. Total Pounds of Feed Required to Produce Indicated Gains on Lambs Fed Various Small Grains

Gains desired per lamb (pounds)	15	20	25	30
Wheat	56	75	94	112
Chopped alfalfa hay fed	99	132	166	198
Days for gain	51	68	85	102
Barley	58	78	97	116
Chopped alfalfa hay fed	106	142	177	212
Days for gain	53	70	88	106
Oats	58	78	97	116
Chopped alfalfa hay fed	103	138	172	206
Days for gain	53	70	88	106
Eastern corn	48	64	81	96
Chopped alfalfa hay fed	84	112	140	168
Days for gain	44	58	73	88
Local corn	44	59	74	88
Chopped alfalfa hay fed	91	121	150	182
Days for gain	43	58	72	86
Speltz	60	79	99	120
Chopped alfalfa hay fed	141	189	235	282
Days for gain	60	79	99	120

Processing Grains for Fattening Lambs

Ground barley and wheat did not give as good results as these grains fed whole to fattening lambs. However, lambs fed ground oats made more rapid and economical gains than those fed whole oats. Steam-rolled barley had a two per cent greater moisture content than whole barley, but even so gave the best results of the group for the one year's trial. Little difference was noted in the market condition of these lambs. At the close of the experiment they were all graded as "good," and it was the judgment of the graders that it would require approximately another 30 days, feeding to reach the "choice" grade.

The lambs and the feeds that were used in this one year's trial were similar to those described on page one. The wheat fed was Turkey, a hard winter wheat grown under dry farming conditions in central Washington. The grains were ground in a hammer mill where a one-eighth inch screen was used. Part of the whole barley was steamed sufficiently to avoid breaking the kernels, and to avoid dustiness which occurred in the feed. About two per cent moisture was added to the whole grain during the steaming process (See Table 9, page 15.

The lambs were fed in open lots, and the weather was exceptionally favorable for this type of feeding during the winter of 1930-1931. During cold damp rainy days, lamb feeders have observed a noticeable amount of whole cereal grains passing through the digestive tract of lambs when these are fed in open lots. No whole kernels of these cereal grain were noted in the group fed under shelter during cold, rainy weather. In the opinion of many practical feeders, lambs that are cold, damp, and uncomfortable do not lie down and ruminate their feed properly, but stand up much of the time, which condition is the cause of much of the feed passing through undigested.

Based on the data "Feed Consumed per Hundred Pounds Gain" in Table 3, one ton of steam-rolled barley replaces 2178 pounds of whole barley and 298 pounds of cut alfalfa hay. The grinding of the barley had a negative value; the ground grain did not produce any better results than that fed whole. The results with the ground wheat were not equal to those obtained by feeding the grain whole. The results with oats were somewhat different. In one year's trial, the

Table 3. Effect of Processing Small Grains for Fattening Lambs.

Ration fed	Barley			Wheat		Oats	
	Whole	Steam rolled	Ground	Whole	Ground	Whole	Ground
No. of lambs	25	25	25	25	25	25	25
No. of days	61	61	61	61	61	61	61
Average Weights and Gains (Pounds)							
Initial wt. per lamb	74.35	74.19	74.35	73.60	74.77	74.61	73.84
Final wt. per lamb	92.80	94.24	93.09	93.44	91.70	91.71	93.39
Total gain per lamb	18.45	20.05	18.74	19.84	16.93	17.10	19.55
Av. daily gain per lamb	.302	.329	.307	.325	.278	.280	.320
Average Daily Ration (Pounds)							
Grain	1.080	1.080	1.080	1.080	1.020	1.080	1.080
Chopped hay consumed	1.726	1.727	1.767	1.708	1.707	1.708	1.708
Pounds Feed per Cwt. Gain							
Grain	357.5	328.3	352.1	332.6	367.2	385.6	337.0
Chopped hay consumed	571.3	525.0	576.0	526.1	614.5	609.8	532.9

grinding increased the rapidity and economy of the gains. One ton of ground oats replaced 2288 pounds of whole oats plus 456 pounds of cut alfalfa hay.

Table 4 is presented for the convenience of the lamb feeder. This table shows the total pounds of various processed grains required to produce desired gains per lamb.

The data from Table 3 are used as the basis for Table 4, except that the calculation is based upon the gross amount of feed necessary rather than on the amount consumed. Multiplying the amount of feed by the price, one will have an accurate check on the amount of feed necessary to produce the stated gains. Ordinarily it will be neces-

**Table 4. Total Pounds Feed Required to Produce Indicated Gains on
Lambs Fed Various Processed Grains**

Gains desired per lamb (pounds):	15	20	25	30
Whole barley	54	72	89	107
Chopped hay fed ¹	89	118	147	176
Days for gain	50	66	83	99
Steam rolled barley	49	66	82	98
Chopped hay fed	81	108	135	163
Days for gain	46	61	76	91
Ground barley	53	70	88	106
Chopped hay fed	89	118	148	178
Days for gain	49	65	81	98
Whole wheat	50	66	83	100
Chopped hay fed	81	108	136	163
Days for gain	46	62	77	92
Ground wheat	55	73	92	110
Chopped hay fed	95	127	159	190
Days for gain	54	72	90	108
Whole oats	58	77	96	116
Chopped hay fed	95	126	157	189
Days for gain	54	71	89	107
Ground oats	50	67	84	101
Chopped hay fed	82	109	137	165
Days for gain	47	62	78	94

¹The amount of chopped hay fed in each case was three per cent greater than the quantity actually consumed.

sary to add 20 to 25 pounds to the average 70-pound feeder lamb in order to have a lamb sufficiently well finished to grade "choice." This gain must be added in approximately 80 to 100 days.

Feeding Whole and Steam Rolled Barley to Breeding Ewes. The results of one year's trial with feeding barley whole and feeding it steam-rolled to good-mouthed⁷ Rambouillet breeding ewes under shelter at Pullman, Washington, show that in two groups of ten ewes there was practically no difference in the amount of gain. Neither was any difference noted in the lambs at the time of birth or in

the ability of the ewes to suckle these lambs. Checks were made to determine, as far as possible, the amount of whole kernels of barley passing through the digestive tract. No whole grains were observed in either lot. A further and more accurate study was made with six ewes fed in digestion crates, where an accurate chemical record was kept of all feed consumed and feces voided. The dry matter in the ration of steam-rolled barley and alfalfa hay had a digestion coefficient of 57, as compared with 55 for the ration of whole barley and alfalfa hay. This small variation indicates no practical advantage from processing the grain. The ewes consumed three-fourths of a pound of grain and three pounds of hay daily.

Processing Hay for Fattening Lambs

The processing of alfalfa hay has little effect upon the hay actually consumed by fattening lambs. It has the advantage of reducing the amount of refuse hay. Twenty-two per cent of the hay fed was refused by the lambs fed long hay, three per cent by those fed chopped hay, and none by the group receiving the ground hay. The chopped and ground hays have the advantage of greater convenience in feeding, storing, and stacking.

On the basis of feed consumed, the ground hay was most efficient, the long hay second, and the chopped hay last. The group of lambs fed chopped hay did not make as rapid gains and required a little more feed per 100 pounds gain. Based on feed offered per 100 pounds gain, it required decidedly more of the long hay than of the other hays (Table 5). If this refused long hay can be utilized for horse or stock-cattle feed, the chopping has a much less important place than in cases where the refused stems cannot be used.

The extremely fine alfalfa flour was not palatable to the lambs. A seven-sixteenths inch screen which left the hay about as fine as alfalfa leaves produced the most satisfactory degree of fineness. The chopped-hay stems averaged one and four-tenths inches in length.

The lambs used in this set of trials were similar in breeding and condition to those described on page one. The hay used was No. 1 green alfalfa, and contained 42 to 44 per cent leaves and 56 to 58 per cent stems. The hay was chopped with a Papee chopping machine. In the lower Yakima valley during the winter of 1930-1931 the rate for

chopping hay was \$2.00 per ton. The grinding entails more expense. The hay was first chopped, then ground by a hammer mill, which grinding cost \$4.00 per ton for labor and power alone. Custom grinding of hay usually means that the hay has to be hauled a comparatively long distance and it costs \$5.00 per ton in addition to the hauling charge.

Table 5. Value of Cutting and Grinding of Alfalfa Hay Fed with Whole Barley

Ration fed	Long hay, barley	Chopped hay, barley	Ground hay, barley
No. of lambs	25	25	25
No. of days fed	61	61	61
Average Weights and Gains (Pounds)			
Initial wt. per lamb	74.00	74.35	74.51
Final wt. per lamb	93.36	92.80	96.69
Total gain per lamb	19.36	18.45	22.18
Av. daily gain per lamb	.317	.302	.364
Average Daily Ration (Pounds)			
Grain	1.080	1.080	1.080
Alfalfa hay fed	2.250	1.780	1.820
Alfalfa hay consumed	1.750	1.720	1.820
Alfalfa hay refused	.500	.060	none
Pounds Feed per Cwt. Gain			
Grain	340.2	357.5	297.0
Alfalfa hay fed	708.8	589.2	500.5
Alfalfa hay consumed	551.2	569.3	500.5
Alfalfa hay refused	157.6	19.9	none
Percentage feed refused (Basis hay fed)	22.2	3.37	none

These lambs gave the following comparative returns from processing hay.

- (a) One ton of long hay was equivalent to 1664 pounds of chopped hay and 49 pounds of grain.

(b) One ton of ground hay replaced 2832 pounds of long hay and 173 pounds of grain.

(c) One ton of ground hay replaced 2354 pounds of chopped hay and 242 pounds of grain.

For the convenience of the lamb feeder, Table 6 contains the total feed fed to an average lamb for periods of time required to produce gains of 15, 20, 25, and 30 pounds. The figures are reduced to the closest whole number. Those who have use for the refused stems should credit the lambs eating the long hay with this amount when figuring the comparative cost of total feed.

Table 6. Total Pounds of Feed Required to Produce Indicated Gains on Lambs Fed Whole, Chopped, and Ground Alfalfa Hay

Gains desired per lamb (pounds)	15	20	25	30
Barley	51	68	85	102
Long alfalfa hay fed ¹	101	134	169	202
Days for gain	47	63	79	94
Barley	54	72	89	108
Chopped alfalfa hay fed ²	87	117	146	174
Days for gain	50	66	83	100
Barley	44	59	74	88
Ground alfalfa hay fed ³	75	100	125	150
Days for gain	41	55	69	82

¹The quantity of long hay fed was 22 per cent greater than the quantity actually consumed.

²The quantity of chopped hay fed was three per cent greater than the quantity actually consumed.

³In feeding ground alfalfa, there was no waste.

Succulent Feeds for Fattening Lambs

Cull potatoes, cull apples, carrots, and corn silage added to a ration of grain (barley 1930-1931, wheat 1928-1929) and alfalfa hay produced more rapid gains than the ration of only grain and alfalfa hay. All groups received the same grain ration. The lambs were fed equal quantities of succulent feeds. All lambs were fed all the hay they would eat in addition to the other feeds of the ration.

The lambs were similar to those already described. The barley was eastern Washington grain. The wheat fed in 1927-1928 was an off-grade white wheat grown in eastern Washington. It contained 15.2 per cent moisture. The hay was No. 1 alfalfa produced at the Washington Irrigation Branch Station, and was fed chopped into lengths of one and four-tenths inches. Very little hay was refused. The silage was grown on the Experiment Station farm, the corn (Reid's Yellow Dent) yielding 10 to 15 tons per acre, and was rated as good corn silage. The mechanical separation of grain and stalk in the silage showed 10 per cent corn kernels by weight. The kernels contained 50 per cent moisture. The apples fed were cull Winesaps, and the potatoes were Netted Gems. The carrots fed during the winter of 1927-1928 were of medium size but good quality and of Danver's Half Long variety.

Badly decayed apples and potatoes were sorted out by hand before chopping this class of succulence. (When whole apples and potatoes are fed, the sheep have a chance to reject the badly decayed ones.) In the case of potatoes, all sprouts were removed, since they contain a substance known as "solanin" which is poisonous. Also, frozen potatoes were fed with care on account of their high sugar content.

The per cent of moisture of the corn silage, cull apples, cull potatoes, and carrots was found to be 71.04, 84.59, 76.79, and 86.59 per cent, in the order named. These figures show the extreme succulence of such feeds. Chemically, the dry matter of apples, potatoes, and carrots resembles concentrates.

From the feed required to produce 100 pounds body gain as summarized in Table 7, the following relationships between the various feeds have been computed:

- (a) One ton corn silage is equal to 134 pounds barley and 911 pounds cut alfalfa hay.
- (b) One ton cull apples is equal to 77 pounds barley and 796 pounds cut alfalfa hay.
- (c) One ton cull potatoes is equal to 311 pounds barley and 1200 pounds cut alfalfa hay.
- (d) One ton carrots is equal to 149 pounds wheat and 409 pounds cut alfalfa hay.

Table 7. Comparative Value of Corn Silage, Cull Apples, Potatoes, and Carrots for Fattening Lambs

Ration fed	Cut alfalfa hay, barley	Corn silage, cut alfalfa hay, barley	Cull apples, cut alfalfa hay, barley	Cull potatoes, cut alfalfa hay, barley	Cut alfalfa hay, wheat	Carrots, cut alfalfa hay, wheat
No. of lambs	25	25	25	25	20	20
No. of days fed	61	61	61	61	99	99
Average Weights and Gains (Pounds)						
Initial wt. per lamb	74.35	73.95	73.68	74.05	77.64	78.78
Final wt. per lamb	93.09	93.73	92.92	95.17	104.28	109.54
Total gain per lamb	18.74	19.78	19.25	21.12	27.64	30.76
Av. daily gain per lamb	.307	.324	.316	.346	.279	.311
Average Daily Ration (Pounds)						
Grain	1.080	1.080	1.080	1.080	.970	.970
Alfalfa hay consumed	1.766	1.458	1.468	1.458	1.960	1.880
Succulence	....	.890	.890	.890	....	1.460
Pounds Feed per Cwt. Gain						
Grain	352.1	333.7	341.3	312.1	347.3	312.3
Alfalfa hay consumed	575.7	450.5	463.9	421.4	701.7	605.4
Succulence	....	275.0	281.2	257.2	....	470.1

Table 8 is a convenience table containing the total feed per lamb necessary for various gains. It is based on rations included in Table 7. The figures for hay are based on chopped hay fed, which figure is three per cent in excess of the hay actually consumed. With long hay the wastage approximates 22 per cent.

Table 8. Total Pounds Feed Required to Produce Indicated Gains per Lamb when Various Succulent Feeds Are Fed

Gains desired per lamb (pounds)	15	20	25	30
Barley	53	70	88	106
Alfalfa hay fed chopped	89	118	148	178
Days for gain	49	65	81	98
Barley	50	67	83	100
Alfalfa hay fed chopped	70	93	116	140
Corn silage	41	55	69	82
Days for gain	46	62	77	92
Barley	51	68	85	102
Alfalfa hay fed chopped	72	96	120	144
Cull apples	42	56	71	84
Days for gain	47	63	79	94
Barley	47	62	78	94
Alfalfa hay fed chopped	65	86	108	130
Cull potatoes	38	51	64	76
Days for gain	43	58	72	86
Wheat	52	69	87	104
Alfalfa hay fed chopped	108	144	180	216
Days for gain	54	72	90	108
Wheat	47	62	78	94
Alfalfa hay fed chopped	94	125	156	188
Carrots	70	94	118	140
Days for gain	48	64	80	96

The Chemical Composition of Feeds

Some knowledge of the chemical make-up of the feeds is of considerable value in comparing one year's results with another's in livestock feeding. Of especial value is a knowledge of the moisture content. One grain containing 10 per cent moisture will have an advantage over another having 15 per cent moisture, even though the dry matter of each is otherwise similar. Also a high moisture content generally suggests poor keeping qualities.

The fact that apples, carrots, corn silage, and potatoes contain 84.59, 86.59, 71.04, and 76.79 per cent moisture suggests immediately a comparatively low nutritive value per pound of feed.

Table 9 may serve as a basis of computing the dry matter as well as fiber contained in the various rations. This table is of especial value to the student of nutrition, in that it makes it possible to compute the various nutrients contained in each ration.

Table 9. Chemical Composition of Feed Fed to Fattening Lambs
(Analysis by Department of Animal Husbandry)

	Water	Ash	Crude protein (N x 6.25)	Carbohydrates		
				Fiber	N. F. ext.	Ether ext.
Grains						
Steam rolled barley ¹	13.15	2.65	7.67	5.04	69.12	2.37
Whole barley ¹	11.29	2.59	10.84	5.67	68.13	1.48
Eastern yellow corn No. 3	16.97	1.37	9.19	1.88	66.49	4.10
Local yellow corn	17.47	1.48	9.10	1.60	66.05	4.30
Oats	10.94	3.99	10.84	9.89	59.81	4.53
Wheat (Early Baart)	10.22	1.91	11.95	2.68	71.54	1.70
Soft wheat (Albit)	15.17	1.93	9.81	3.08	68.10	1.91
Roughages						
Ground alfalfa hay	15.00	7.80	12.55	28.27	34.43	1.95
Chopped alfalfa hay	15.00	7.80	12.14	28.28	34.84	1.94
Succulence						
Apples	84.59	.38	.29	1.07	13.23	.44
Carrots	86.59	1.39	.68	1.77	9.29	.28
Corn silage	71.04	1.98	1.77	5.87	18.20	1.14
Potatoes	76.79	1.15	2.07	.55	19.24	.20

¹The steamed and whole barleys came from different sources which accounts for the difference in chemical composition.

SUMMARY

The comparative feeding value of Washington-grown and eastern No. 3 corn depends upon the moisture content and the physical condition of the corn. No difference was found in feeding eastern No. 3 yellow corn and local yellow corn, both containing about 17 per cent moisture.

Hard winter or spring wheat grown under dry land conditions in central Washington, eastern Washington-grown heavy barley, and oats were about the same in feeding value. All three ranked below corn.

Dakota-grown speltz was not as good a feed as local grains.

Steam rolling barley increased the feeding value in one year's test, while grinding was of no benefit.

Ground wheat was inferior to whole wheat.

Ground oats gave slightly better results than whole oats.

Chopping or grinding hays did not increase consumption of them, but did reduce the amount of hay refused by the lambs. Those fed long hay refused 22 per cent of the hay fed, while those fed chopped hay refused only three per cent, and the ground hay was consumed without waste.

Cull potatoes proved to be the best succulent feed. Corn silage followed, while cull apples were last. Carrots were about the same in feed value as cull apples. Nevertheless, if cull apples or carrots are available, they can be satisfactorily employed as indicated.

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